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RECENT DEVELOPMENTS IN LANGUAGE LABORATORY EQUIPMENT FOR TEACHING AND RESEARCH.

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THIS PAPER WHICH WAS PRESENTED AT A CONFERENCE ON THE PLANNING AND OPERATING OF LANGUAGE LABORATORIES DISCUSSES THE EQUIPMENT CONTENT OF THE LANGUAGE LABORATORY. DESCRIPTIONS OF THE VARIOUS ITEMS OF MECHANICO-ELECTRONIC EQUIPMENT WERE GIVEN UNDER THREE HEADINGS--(1) STIMULUS GEAR, COMPONENTS THAT PRESENT AUDITORY AND VISUAL MATERIALS, (2) RESPONSE GEAR, EQUIPMENT THAT RECEIVES AND REGISTERS STUDENTS' VERBAL RESPONSE, AND (3) CONTROL GEAR, EQUIPMENT THAT REGULATES AND COORDINATES THE FUNCTIONING OF THE STIMULUS EQUIPMENT OR PROVIDES A MEANS FOR THE STUDENT TO CHECK ON HIS OWN LANGUAGE PERFORMANCE. RELATED REPORTS ARE ED 003 919, ED 003 924, AND ED 003 926. (AL)

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RECENT DEVELOPMENTS IN LANGUAGE LABORATORY EQUIPMENT FOR TEACHING AND RESEARCH

F. Rand Morton

INTRODUCTORY STATEMENT: The College Language Laboratory has been recognized by educators and language teachers as an effective tool for language instruction for somewhat more than fifteen years. Surprisingly enough, fewer changes have taken place with regard to its component parts and their pedagogical use than one might have expected from a decade of experience. The lab installation has certainly become larger; the average college lab today serves between 60 and 100 students simultaneously on a library basis where some years ago its average size was only 10 to 30 student booths. Where size has not increased, the lab has simply "multiplied" within a given institution, with a series of individual "classroom" labs built to serve smaller groups (in class or out) of students of different languages. At the University of California at Los Angeles, for example, there is an English Language Lab, a German Lab, a French Lab, and perhaps now a Spanish Lab. It is difficult at the moment to guess which type of installation--the library lab or the classroom lab--each with its peculiar equipment needs and pedagogical operations--will be adopted by a majority of institutions in the future. Recent trends seem to indicate a slight preference for the lab operated on a library basis. Ideally, as long as any elementary language instruction is done in the classroom, it would seem that all colleges should have both types of installation. Several do now (The University of Michigan, Indiana University). Since neither the increase in size nor the number of lab installations make important innovational demands on the lab equipment itself, we may find in this fact an explanation for the continued persistence of mechanico-electronic precedents established years ago with regard to lab equipment. To this subject this work paper will attempt

to speak, after suggesting a first conclusion: that the popularity and usefulness of the college lab, evidenced by its growth, has thus far for the most part discouraged or left no time for a serious investigation of the contents of the lab. Size and number have taken precedence over form and content. A situation not limited to language labs...and happily one to which there are exceptions. Finally, and most recently, the concept of the "teaching machine" has been felt in the lab and has, among other things, suggested ways in which the lab can serve profitably as a research tool. Should this function become a real one in the lab, we can be sure that more attention will be given to its component parts in the future.

CLASSIFICATION OF LANGUAGE LAB MECHANICO-ELECTRONIC GEAR: There are a variety of ways to designate and categorize the different mechanico-electronic components found in today's lab. The one which I shall use here looks primarily to the functional use of the items it describes which seems most helpful for the purpose of the present paper. It establishes three broad classes of equipment: stimulus gear, response gear, and control gear. By stimulus gear I shall refer to those component parts whose function is to present to the individual student both the auditory and visual materials afforded him as models for his own verbal behavior or as stimuli to trigger pre-taught verbal responses. By response gear I designate that equipment whose primary function is to receive and register in some way all that the learning student says (and to some extent does) while in the lab. Control gear, finally, categorizes that equipment whose primary function is either to regulate and coordinate the functioning of the stimulus gear or to provide the student with a means for checking (feedback) on his own verbal behavior. This same equipment, of course, can serve for data collection and recording equipment for the purposes of research in applied linguistics and the psychology of language learning.

I STIMULUS GEAR

A) Audio

1) Playbacks (tape)

a) reel-to-reel

It is discouraging to report that little has been done in this important equipment area. The majority of college labs continue to use some form of a reel-to-reel tape transport made by one of three companies (Viking, Bell, V-M) whose basic patterns are now at least ten years old and which were created originally for the home tape-recorder market. Few are of heavy duty, industrial use construction for use on the continual forty hour a week basis that many of them receive in the lab. All require constant attention while in use and considerable service and maintenance time. Companies building more ruggedly designed equipment (Ampex, Crown, Magnecord) have been slow in entering the language lab field and few labs today are using their equipment. Tape transports designed for multiple track playback rarely permit more than two channel simultaneous audition. Elton Hocking (Purdue) in collaboration with Stancil Hoffman Corporation has recently designed and installed a tape transport with associated amplifiers which permits both the recording and playback simultaneously of a large number of audio channels laid down on wide tape, sixteen channels being theoretically possible on a one inch magnetic tape. One can foresee difficulties, but this is, nevertheless, the first major effort to provide a maximum number of independent audio channels with a minimum of mechanico-electronic equipment designed to operate automatically over a long period of time in a remote position.

In spite of the great room for improvement, it seems clear now that the reel-to-reel tape playback transport is not the best suited as a playback device in the lab. Automation of this equipment is difficult (e.g. automatic reverse, forward, rewind, etc.) and rarely successful. Too much time is lost in its use. When placed in the student's booth it distracts and when placed at the teacher's console or the control center it demands constant attention. As a presentation or stimulus device it has no particular advantages.

b) cartridged reel-to-reel

The RCA cartridge (released now for unrestricted use to American Moulded Products and adopted primarily by MRI for lab use) solves some of the problems of the conventional reel-to-reel playback. Automation of playback and operational modes can be more easily accomplished but still not entirely satisfactorily (too much time being now required in changing from mode to

mode.) Cartridges can be loaded without too much difficulty and once closed may be easily catalogued and filed. Quarter inch tape is used, at present permitting a maximum of four independent audio (or record) channels, although none utilize this potential as yet. Playback transports designed specifically to handle this cartridge (by Viking, Bell and others) are much simpler and more ruggedly constructed than the conventional reel-to-reel transport. That of Bell (MRI) is the first tape transport designed specifically for use in the lab. Chester Electronics has also recently developed a special transport, designed specifically for lab use, to handle both the RCA (four tracks and a modified RCA cartridge loaded with one or two inch tape and capable of providing, with the latter, up to thirty-two different audio playback (or record) channels. Since the Chester transport utilizes three heavy duty motors (MRI uses only one) all the operation modes are actuated electronically rather than mechanically and rewind time is rather infinitesimal. In its field it seems the most promising piece of gear yet to emerge. Both it and the MRI transport are presently in production. There are other reel-to-reel cartridges and cartridge handlers, similar but not identical to the RCA but with no particular advantages (Linguapac). Other language laboratory firms (Califone) have modified existing (Bell, Viking) reel-to-reel tape decks, anchoring the magnetic tape to both reels and covering that portion of the transport, so that these machines operate, seemingly, in a manner similar to those of the true cartridge-designed transports. This seems a less than happy arrangement.

Columbia has recently announced a new type of "self threading" reel-to-reel cartridge and transport unit using one-eighth inch magnetic tape. It is difficult at first blush to foresee specific uses of this equipment for lab use but it should certainly be investigated.

In general, the reel-to-reel cartridge and its transport offer several advantages over the conventional reel-to-reel transport. Some have been suggested. They can certainly be placed with less misgivings both in a remote location (automatically controlled) or in the student's booth for his own operation without requiring or provoking attention and thus with minimum

distraction to the student. They are more ruggedly built and should last longer, with less service or maintenance, than the conventional reel-to-reel playbacks. (The Chester equipment has been built to military specifications and should last ten to fifteen years with twenty-four-hour use.) The cartridges will not hold a tape as long as the reel-to-reel transports, but this does not seem a disadvantage. (They can be "rigged" to provide an automatic two-hour continuous program with only two short pauses for rewind.)

c) continuous-loop cartridges

These cartridges contain a single "reel" from which quarter-inch magnetic tape feeds itself across the playback heads and then rewinds itself in one continuous movement. Two such cartridges currently available (Fidelipac, Cousino) have proven themselves highly reliable (more so, certainly, than any reel-to-reel cartridge). Special transports--which due to the minimum requirements for moving parts made by the loop cartridges are easily (and inexpensively) made rugged and trouble free--are now manufactured by several companies (Viking, Conley, Cousino, Linguatrainer). Due to its peculiar operational characteristics, a number of loop cartridges can easily be stacked and played on a single, common-mandril type transport. Theoretically twenty or thirty cartridges, each containing four quarter track recordings, could be handled by a single transport in less space than that required now for a conventional type recorder.

Other similar cartridges (Pentron, Viking) have appeared but not proven themselves as reliable as the first two mentioned. (See the technical report on loop cartridges made by Amplifier Corporation of America for the U. S. Navy, Division of Training Devices.)

Surprisingly enough, the endless loop cartridge with its impressive advantages as a presentational or stimulus device has not been exploited to the extent one might expect in the lab. The explanation is historical. A loop tape seemed the most natural means for the playback of pre-recorded materials on a regular schedule in the early days of the language laboratory. Many tried it. Unfortunately, the loop devices then available were not

satisfactory nor were there special transports designed specifically to handle them. The resulting unhappy experience soured many experimenters and it has apparently not yet been forgotten. On the other hand, in The University of Michigan's lab all playbacks are of the loop type and have been for several years. At present, thirty-three are used simultaneously to provide up to forty-five different instructional programs, also simultaneously. They operate from 8 a. m. until 10 p. m. daily and need little care or supervision. A new language laboratory system, now being installed, will continue to use these loop cartridges, expanding their number to one hundred and making available through multi-track recordings some four hundred individual simultaneous programs.

As simple presentational or stimulus devices the loop cartridge and its associated transports have no disadvantages (in the mind of the writer) if the teaching materials used are appropriate and well designed. Many persons feel that the present (although not inevitable) lack of fast forward and reverse on these loop transports severely hinder their <u>pedagogical</u> application. But this then involves pedagogy. Another criticism often heard is that multiple channel recordings are difficult since each program track laid down must of physical necessity be the same length. But again, a pedagogical consideration not a mechanical one. Two points against the continuous loop cartridge can be made, however. Because of the peculiar manner through which the tape winds and reels off, slipping always against itself, some binding and resultant malfunction may be expected, particularly if used in areas where heat control is a problem. For the same reason it is doubtful that a tape any wider than one quarter inch can be successfully used in such a cartridge--presently limiting the number of tracks to be laid down to four on each. Secondly, the two companies now manufacturing these cartridges have priced them so exorbitantly high that one feels a little ridiculous in purchasing them. (The RCA type cartridge and the continuous loop cartridge cost approximately the same in manufacture, but their retail price, minus the usual educational discounts, separate them too widely to permit comparison. Tant pis.)

Finally, it may be said that, for library lab installations where students are permitted to check out master recordings for individual drill, the loop tape playback linked with other equipment for dubbing seems most ideal. The cartridge can be treated much as a book and when it is placed in operation it has minimum distraction for the student. The tape playbacks and cartridges discussed above are no longer experimental but long proven in the field and hard to improve in the future. They have not yet been exploited fully in the college lab but those wishing to do so can begin now with confidence that the equipment available will meet satisfactorily the most demanding requirements he can make. There will be improvements. But a new kind of recorder-playback, the extruded memory drum, is also in development and may in the next five or ten years prove a more useful tool for language training than the tape cartridge.

2) Playbacks (records)

a) acetate and vinyl

There seems nothing spectacular to report for this type of playback equipment; no radically new advances are easily possible or urgently needed. With the acetate (do-it-yourself) disk almost entirely abandoned by the language laboratory, and the commercially made vinyl disks increasingly replaced by tape, little new will probably happen here. On the other hand, new, inexpensive and easily packaged plastic recording materials (as that used in the "record booklets" of the Modern Language Project of the Massachusetts Council for Public Schools Inc.) may easily revolutionize the concept of "homework" for language instruction and stimulate the development of miniature "pocket size" record players for use by students in study halls and homes. A record playback designed specifically for individual student language lab booth use has recently been developed and placed on the market by the Newcomb Audio Products Company and incorporates several excellent features. Califone now makes available a long series of fairly expensive and excellent quality playbacks with special cueing devices which would enable the student quickly to locate a desired passage on a record and repeat it as often as he wished. B. F. Skinner of Harvard has also been designing

such a playback, which would permit the student to select accurately an even more minimal portion of the entire recording, but his is not yet available. Record playbacks are easily available now with multiple output jacks to permit a sizable group of students to audition with earphones a particular recording. But this is hardly innovational. Possibly, when the potentials of stereo recording to shape verbal behavior are more fully known, the record player will again seem useful for general language training. The use of the "rhythm machine" (another development of Skinner which operates in part as a record player) in language training may also make us return to consider them.

b) magnetic disks and belts

Only one company (MRI) now manufactures a magnetic disk playback (and record) for the lab, employing, incidentally, a patent issued first in 1898. The operation is similar in all respects to that of an ordinary record playback. Latest models of this equipment have a built-in erase head and mechanism and circuitry is even available to permit complete remote control of all the playback's functions, including repetition of a given passage. Original skepticism regarding the quality of sound reproduction obtainable with the magnetic disk remains alive and justified in the minds of many. Present quality is just barely passable and cannot compare to that of tape (excessive noise, poor erasure, incomplete frequency spectrum). Better quality could be obtained immediately if the company would use superior materials in the manufacture of the disk, but at best it is doubtful that the resultingly more expensive disk could equal the performance of tape, all other associated components being equal.

Aside from quality, the magnetic disk, when placed as usual in the student's booth, has high distraction appeal. For this reason, it is not often used as a stimulus device, the master recorded materials normally being placed on tape and channeled to the student's earphones and disk recorder for simultaneous response and dubbing: that is to say, the magnetic disk is used primarily as a recording facility (response and control devices), not as a stimulus device. But if the student needs to record his voice at all

(for purposes of language learning) it is when he works to discriminate and reproduce the sounds of his target language. It is precisely for this critical acoustic phase of language learning that the sound quality of the magnetic disk does not now seem to be adequate. (but see below, 7, a)

Magnetic belts, as used principally in the language lab equipment manufactured by Dictaphone Company, suffer, in general the same disadvantages of magnetic disks and, if anything, perform less well. In both belt and disk it is possible that spacing between recording grooves is insufficient to provide good results with present recording procedures.

Due to its simplicity and ease of handling the magnetic disk or belt is perhaps most useful for purposes of student testing when pronunciation is not important. A master or live recorded test may be administered quickly and easily to a large group of students in booths equipped with magnetic disk recorders, the test recording collected and graded in less than half the time necessary if recordings have been made on tape.

3) Playback heads (magnetic)

In the last two years miracles have occurred here and more will occur soon. Apparently, college language labs are the last to hear of them since labs continue to employ heads provided by equipment makers rather than head makers, and rarely insist that these heads meet any particular specifications. Suffice it to say that major magnetic head companies (Brush, Bernard Lipps, Michigan Magnetic, Nortronics, Shure) can provide playback heads to meet almost any specifications laid down. Cost for the best would be similar to what many now pay for the worst.

4) Pre-amplifiers (playback)

The pre-amplifier (necessary to boost slightly the audio signal output from the playback head or phonograph cartridge) prior to power amplification from the amplifier presents no real problem today nor serious need for improvement as far as its use in the lab is concerned. Traditional circuits and many well-proven commercial units are readily available. One point may be made here. It is possible that future controlled experimentation will substantiate the opinion of many now that some skewing of the frequency (output) curve--

boosting by some 10 to 12 db the amplitude of frequencies around 200 cps. and around 7000 cps. --may facilitate for the student the quicker discrimination of all such speech sounds. Typical pre-amps now used in labs permit no such random boosting within the output frequency curve. When and if a company undertakes to design an integrated set of electronic components for the lab (playback head, pre-amp, amplifier, earphones, mikes) this potentially valuable mechanico-electronic control might well be incorporated into the pre-amp. (Such skewing is now normally done--when it is--in the master recording itself. In the long run it may be wise to leave it there.)

5) Amplifiers

Conventional tube-type, chassis-built amplifiers are still in most general use. Recent advances in etched or printed circuits, transistorized components, and flat-board, plug-in mounting provide considerable improvement for modular construction, servicing of equipment and space saving. No new labs should be installed without such amplifiers. In performance, however, little has changed. Good dependable amplifiers are still difficult to find and costly. Among them, those of Bernco, Califone, Chester, Linguatrainer are representative. Minimum specifications for language lab use (easily met with good design) are as follows:

Frequency response ±2 db, 80-12,000 cps.
Harmonic Distortion: no more than .2%, 200 to 15,000 cps. Measured as RMS voltage of total harmonic components up to 40 kc.
Output level OVU at 1000 ohms
Noise -65 db. ref. 15 dbm output
Maximum unclipped signal output 8 volts RMS
Gain: 75 db.

Ironically, it appears to cost very little more to build a good amplifier than a poor one. Between the two, perhaps the greatest important difference (for the lab) is that of inherent noise. Amplifier circuits which behave beautifully (no noise) when used with loudspeakers may be impossible when used with earphones. All "traditional" amplification circuits have been engineered primarily for speakers. Few amplifier circuits have been designed specifically for headphones. Hence the scarcity of good ones. Ideally, amplifier,

earphone, mike and pre-amps should be designed "together" as a single, electronically integrated circuit. This has yet to be done by a language lab equipment manufacturer.

6) Headsets

Traditionally, this lab component, the phones, has been the weakest link within the lab's acoustic chain. As in the case of magnetic playback heads, much has recently happened but few college labs have been informed. To summarize: High impedance phones (crystal) cannot transduce with the sound quality necessary to facilitate discrimination of new language sounds. Low impedance magnetic or dynamic phones seem most appropriate for this with preference for the latter. These phones require perfect matching with associated amplifiers, and being less efficient than high impedance phones, they must have ample power to drive them. The best military phones available today "too expensive for the language lab", have a smooth or "usable" response of between 50-8000 cycles. High frequencies may be transduced but at too low a volume for easy perception. (Enthusiastic claims of commercial language lab companies for phones which extend to 12 or 14,000 cps. are simply misleading.) Aside from attenuation at low and high ends of frequency range, no other type of distortion should be noticeable. Quality of sound is also affected importantly by the phone housing and ear-piece. Unless this unit entirely covers the ear, fits snugly against the head and permits the necessary distance between the diaphragm of the phone and the student's ear--and the necessary distance between the diaphragm of the phone and the back of the housing --the sound will be inferior. The same ear-piece should also guarantee at least a 40 db. rejection of ambient room noise. Headsets which meet these minimum specifications are few in number and relatively expensive. Among them: Sharpe Circumaural Phones (temporarily unobtainable), Telex-Dyna-Twin phones, Chester HPC-106, Koss phones (whose head bands are too flimsy for language lab use).

The well-known, wartime Permaflex earphones, occasionally found in surplus stores today, have been used most successfully in a number of lab installations. Despite its ridiculously low price of seven or eight dollars,

it is questionable to equip a lab with components not easily available in stock for either replacement or future expansion. For ease of maintenance, a good general rule would be to use only one make and model throughout all lab installations in any one institution for each individual component part making up the lab.

In addition to the above acoustical specifications, the lab phone should be ruggedly made, lightweight, indestructible. The relatively few phones which meet all these specifications and are presently on the language lab market indicate how much work must yet be done in this area of equipment... perhaps the most crucial of all in a lab.

7) Tape (magnetic recording)

The most interesting development here is the so-called "sandwich tape" now under development and in experimental use by Minnesota Mining and Manufacturing Company. Unlike conventional magnetic tape which provides a recording surface of iron oxide on a plastic backing, the new 3M tape (experimental number LR 1117) places the iron oxide layer between two coatings of acetate plastic. The oxide, then, does not come into physical contact with the recording and playback heads, while the plastic coating, which does, keeps them clean and without wear. Only disadvantage is a slight loss in the high frequency output which can be easily equalized in pre-amplification. For multi-track machines where head wear is important this new tape will indeed be valuable.

Conventional audio-range tape--no matter its manufacture--seems more or less standardized today. Scotch, Audiotape and Irish are among the most popular and equally satisfactory for student copies of recorded materials.

For master recordings, personal experience indicates Scotch #131 or #138 to be useful. In recording materials in which isolated sounds are utilized (as in some pronunciation tapes) a high output tape such as Scotch 120 may best be used since this permits a low recording level, minimizing print through and signal-to-noise problems. Lubricated (or "greased") tape for use in loop cartridges is made by several companies, that of Soundcraft (#441 and #442) being one of the best.

In language lab use, the problem of print through in magnetic tape recordings seems the most important one to overcome at the moment. Sandwich tape may help here too, but correct recording techniques and tape storage may be the most important manner of minimizing its presence.

8) Program distribution or selection equipment (audio)

The problem of making available to the individual student that particular lesson, or minimal portion of a lesson, which he or she needs, to permit each student to proceed at his own learning pace, the primary justification for any lab, has long presented perhaps the most difficult operational or functional problem in the college language lab, particularly in those utilizing a library lab system. Two different operational methods have obtained over the years: a) permit the student to withdraw from a central library the particular lesson, or lesson segment, and work individually with it at a booth, exchanging it for another when necessary; or, b) channeling through a switching arrangement and associated audio lines the desired lesson or lesson segment being played at a central location within the lab. In the second method, the selection and channeling of the recorded material may be accomplished either by a monitor at the central playing location (control center) or by the student in a booth. Recently a compromise method has been used in many installations which channel to the student the pre-recorded master lesson which is then copied by the student on the tape or disk recorder in his booth. On first audition the student, of course, has no control over his material; on subsequent playings of his copy he is at liberty to control its presentation. Advances in equipment utilized in each of these distributional systems can be briefly reviewed.

a) <u>Master library system</u>: The easy availability of sufficient copies of each pre-recorded tape to permit students desiring a copy to work simultaneously has long been a requirement for this system. Copying of tapes (with adequate quality control) has and will continue to be a difficult task in the lab. Recently multiple tape copiers with good specifications have been made commercially available by MRI (at a cost no longer prohibitive) and Magnecord, which should considerably lighten this task and makes

its system far more feasible. Too, a number of commercial companies now undertake to provide such a copying service at a reasonable fee. The use of cartridges also implements this system by assuring that copies will not be damaged or erased. More important, here is the development of the wide tape cartridge on which up to thirty-six lesson segments can be laid down on as many channels. A student could presumably check out one or two such cartridges and work with them for an entire week. While working, the student would progress from one segment (channel) to another by push-buttons connecting the thirty-two playback heads on the playback transport in the booth.

The use of commercial vinyl records or magnetic disks to provide multiple copies of master lessons presents too many problems as long as cost and sound quality are important considerations. When sound quality is not important (and at a certain advanced point within the linguistic progress of each student it should cease to be--as witness the materials used at Yale's Far Eastern Institute) the magnetic disk would prove perhaps the easiest means of duplicating master lessons for distribution to individual students. But special equipment for multiple duplication of magnetic disks does not yet exist.

b) Central library system: It is pleasant to report that major "breakthroughs" have been recently made in language lab channeling and program selection equipment. In the past, if more than one lesson channel were to be provided in the student listening booth a manually operated, rotary selector switch has been necessary, placed either in the student's booth (for his use) or at the monitor's console, (central control) for use only by the monitor. In the second position, the rotary contact switch has performed fairly well when high grade units were employed. In the student position, particularly when the number of contact points exceeded twelve, their trouble-free operation has left much to be desired. More important, the rotary selector switch of twelve or more positions requires a wiring complex that discourages the most optimistic engineer. Whenever two or more audio cables containing separate programs are in close proximity, the problem

of cross talk and hum must be dealt with and it is difficult to do so successfully. This fact, as well as expense, has discouraged most language lab equipment makers from supplying more than eight or ten independent audio channels for selection from student booths--and has limited the number to be selected by the monitor in the central control station to a maximum of forty or fifty. At the same time, the pedagogical and operational advantages of making available for student selection as large a number of independent audio channels as possible (particularly in the library operated lab) have become increasingly obvious. To solve <u>all</u> of these problems a number of advanced distributional systems have recently been developed especially for language lab use. These are:

i) The Stroger switch: This is the step-circle switch traditionally used in large telephone exchanges. It can handle a relatively limitless number of program channels, selection being done either by student in booth or by monitor through a conventional telephone dial, and it requires only two audio leads per booth. Disadvantages: relatively expensive as a capital outlay (but less expensive over a twenty-year period than any other equivalent system); difficult to provide 100% trunkage (although this may not be necessary in the lab); requires considerable space. (Typical installation at Florida Presbyterian College, Professor Trakas.)

ii) Dial X step switch (Kellogg, Stromberg-Carlson): This is a switch which moves vertically and is limited practically to a pre-determined number of channels (e.g. 20-40-80.). Selection is effected either through a dial or push-buttons in booth or central control. Least expensive of new switching systems (approximately $50-$80 per booth). Disadvantages: relatively limited number of program channels without doubling original cost; systematic preventive maintenance required; theoretical potential of intermittent cross-talk. Particular advantages: program selection can be additive [student dials 3 digit lesson number (F 10) and then selects segments or lesson (always in numerical order) by dialing only one digit (1 for first segment; 2 for second). Ability of student to dial each succeeding single digit could be made dependable on his achievements within preceding lesson segment.]

iii) Cross-bar switch (North, Kellogg, Western): Unlike above-mentioned switches, the X-bar employs no mechanical or motor movements but selects through a system of energized relays. Expandability of program channels is virtually limitless and both initial and expansion cost is small. It requires little or no maintenance and has a service life of twenty years. It requires minimum space and installation time. Selection is made through dial at student's position or central control. It has maximum flexibility (100% trunkage), minimum noise characteristics. Typical installations (in progress) at The University of Michigan (2,500 program channels) and University of Georgia (Howard Jordan, 100 channels).

iv) RF tuner and multiplexing: Unlike the above mentioned switches, tuning and multiplexing systems require either one or no audio cables between student booths and master playbacks. Recorded programs are "broadcast" and selected at student positions much as one would tune a radio. Disadvantages: In its present experimental stages this equipment imposes serious limits on the number of program channels to be made available. Cost is also relatively high. While potentially capable of simplest installation and operation, as well as superior sound, it will forfeit the special advantages that electro-mechanical switching systems (above) have in controlling other language lab gear (response and control). In general, the less physical motion necessary in any switching system, the more dependable is its general operational characteristics. At present, the Cross-bar system seems most appropriate for language lab program distributional needs. Solid state switching, however, is now in developmental stages and should be available within the next five to seven years. This system, with almost no moving parts, would seem close to ideal. Electro-magnetic rotor switching is also a distinct possibility in the future.

With regard to any program distribution or selector system--be the number of programs involved two to two thousand--perhaps the most important consideration is that of minimum noise and crosstalk. As soon as more than <u>one</u> audio signal is utilized in a laboratory the problem of crosstalk (the "infiltration" of one channel's audio signal into that of another) becomes

a very real and perplexing one. There exists, however, a general rule which, if followed, should minimize this kind of audio disturbance. Stated most simply it would be this: There should be no such thing as a common ground in any language laboratory unless it ties together, finally, a bank of remotely positioned amplifiers. Strict adherence to this rule would obviate much expense in equipment maintenance and much traditional frustration.

B) Visual

1) Motion picture, slide filmstrip projectors, viewers

Interesting developments along these lines can best be discussed under the heading of Audio-Visual. All of the equipment listed has at least become, according to the manufacturers, "easier to thread" and capable of automatic operation. Let it simply be said here that both manufacturers and language lab personnel have been rather unimaginative with regard to the design and use of the "viewer"--a basically simple optical device that seems to have tremendous potential for the language learner. There are some now which give a surprisingly fine, large picture and could be used in a variety of ways in a laboratory booth. But perhaps final responsibility lies with language lab materials makers to give us something to use in them.

C) Audio-Visual

1) Motion-picture projectors

Sound motion-picture projectors continue to sound poorly and make far too much noise to recommend them overly for language lab classroom or library use--a situation which has existed for the past twenty-five years. Most important technical developments here are in the field of the cartridged sound-film projectors and the "packaged" or "suitcase theatre". The cartridged sound-film permits repetitive showings of up to fifteen or twenty-minute sequences and is small enough to be used in a large booth. Again materials are necessary. The "packaged" projector, screen, and sound system permit all of these units to be picked up by one hand and set in front of a class for the most momentary use.

2) Slide and filmstrip projectors with synchronized sound

A number of companies now manufacture integrated sound-still picture presentational units that are small and easy enough to operate to commend

them to language lab or classroom use. These systems require a control channel on either tape or records on which "blips" have been recorded to trigger the frame-advance mechanism of the projector. Representative makers are Synchro-Mat, Applied Communications Systems. But what should quickly revolutionize all language teaching materials, and language laboratories as well, is a sound-on-filmstrip projector now under development by the Victor-Kalart Company. It will be available next September. Sound and picture are recorded on the same filmstrip. Synchronization of picture and spoken text is therefore perfect. The projector itself is the size of a portable typewriter and can be used easily in a student booth. Multiple copies of individual films are inexpensively made. This piece of equipment alone could take the place of all the component items enumerated thus far in this paper. It is certainly the most exciting new development in audio-visual tools yet to appear.

3) Closed-circuit television in language laboratory

CCTV may best be considered an audio-visual distributional device rather than a playback device. It would permit synchronized sound and picture (now either still or motion) to be channeled to student booths from a remote position. Unfortunately no experimentation along these lines has come to my knowledge.

II RESPONSE GEAR

A) Audio

1) Simultaneous

a) microphone

Microphones in the college lab have been a constant source of worry. Few good ones are currently available but a number of companies are working to produce mikes to meet language requirements. One has already emerged (Chester-Telex HMC-1). Its description follows: boom type, attached to left earpiece of headphones, light weight (4 oz.), small (size of a dime), low impedance dynamic (1000 ohms), frequency range 70-10,000 cps plus or minus 3 db.; close-talking, noise-canceling (cancels out all room ambient

noise to -45 db.). This last means, effectively, that an acoustically treated booth is no longer necessary (for purposes of sound absorption--psychological isolation by booth is still highly desirable in the library type lab). In addition, the mike's close-talking characteristics oblige the student to speak at a normal conversational level; this reduces overall average room noise almost 70% and discourages the student from distorting target language speech sounds by overemphasis or the use of excess energy. (But it also places a high responsibility on the master voicer to produce natural, non-stressed speech sounds for the student to imitate.) Judging by work in progress now, decisive achievements in microphone construction will take place in the next five years. Even now it can be said that the Chester-Telex mike and others like it soon to be released make obsolete all microphones now in lab use. One word should be spoken against the ridiculous notion that the student's microphone may be held in his hand or positioned in front of his mouth on a goose neck. Both procedures hinder to some degree the ability of the student to respond naturally to the audio stimuli perceived. Language students, like others, should sit up straight, not hunch, be unencumbered and free to make needed gestures.

b) student amplifier

Most language labs provide circuitry to permit the student to hear in his earphones his oral responses simultaneously as he makes them. An appropriately equalized amplifier is necessary for such procedure. Such an amplifier should meet all of the specifications already cited for the playback amplifier (I, A, 5, above).

c) motor response facilities

The process of training auditory discrimination in the lab can (it seems now) be speeded if the student is provided with a response key or "button" with which he can respond quickly to the auditory tasks of matching to sample or yes-no discriminations, and even true and false tests. Much experimentation needs to be done to determine the most effective type of response mechanism here but the existence of any such device would make serious demands on associated lab equipment. It would mean, among other things, that each

teaching or lesson program would require not only a "program channel" but a control channel. Dual channel playbacks (and complementary distributional systems) would be required. This may point finally and once again to the use of individual, dual-channel tape playbacks in each lab booth and the use of individual pre-recorded lesson tapes for student use. (The laboratory workbook--now becoming popular--is unquestionably a "response" facility in the lab. Due to its textual nature it falls outside the considerations of this paper. But its use certainly implies a student booth sufficiently uncluttered to permit its use.)

2) Delayed

a) student recorder

Whether language students should be given the means for recording their responses to permit self-evaluation on delayed playback has long been a bone of contention within the lab. Opinion still seems evenly divided. The fact that "feedback" or "reinforcement" (which is what this procedure attempts to provide) must be accomplished within approximately three seconds of the initial response to be optimally effective would indicate that the delayed feedback provided by conventional tape recorders or even magnetic disks is hardly useful. While the question remains undecided it seems unnecessary to discuss the point (and its implications for equipment) here. It can be said that at present all equipment used in the student's booth for the purpose of recording his own spoken responses leaves much to be desired but is not critically in need of improvement. It should, of course, meet the minimum specifications already submitted for the student amplifier as far as frequency response and distortion characteristics are concerned. (Few do.)

One innovation here should be mentioned. The use of a cartridged loop tape permitting recording time of one, two, and three seconds has been proposed by at least one language lab company (Conley) but to my knowledge never developed commercially. Use of this cartridge and associated transport and amplifier would permit the student, whenever he wished, to hear immediately played back the last one, two, or three seconds of the master lesson and his own responses. (Intervals of five, ten, and fifteen seconds

could also, of course, be provided, as well as any other series.) If he worked individually with the master tape (cartridged) he would lose none of the master lesson as he stopped to hear the playback, since the master tape would cease to move during the playback time. There are certainly possibilities here.

b) counters

Similar to the motor response facilities for immediate response is the counter facility which experimentation may advocate for delayed response. Operating on an accumulative basis, these counters (activated either by student operated "answer buttons" or voice activated relays) are able to give the student an objective (statistical) evaluation of his work, show him where he needs more practice and, in some cases, make it impossible for him to proceed to new materials until his achievement on present ones is adequate.

In summary, the response gear of the lab is at present minimum and stands in need of far greater research, experimentation and development than either stimulus or control gear. One explanation for its present meager development may lie in the similar paucity of scientifically designed language lab teaching materials which would be the first to requisition and prescribe the response facilities for the students. At the moment, the student in the lab works pretty much in a vacuum with regard to information, or feedback, to help him make and control his responses.

III CONTROL GEAR

A) Monitoring facilities

1) Language lab monitoring console

The "electronic console" and turret assembly usually provided in the classroom-type lab--less frequently in the library type--should most appropriately fall under the category of "response gear." It exists, theoretically at least, to provide the student occasionally with information regarding his work and progress. In practice this seems rarely to be the case. Particularly in the classroom laboratory where students are listening and perhaps recording a relatively lengthy (fifteen-thirty minute) lesson, it is almost dangerous for the teacher-monitor to "cut in" and make suggestions or corrections on a

particular segment of the lesson, for the result may be that in correcting a minor error far more important material will be lost and the student must wait a considerable length of time before he can hear it again. The monitoring console which provides means for the student to call the monitor's attention has at least the advantage of permitting the student himself to decide if he wishes to spend a minute or two under the direct tutelage of the teacher. Whether he should be permitted this decision is another question.

In the library operated lab the central monitor console is at best awkward from a pedagogical point of view. Its presence assumes that the teacher at the console is able to monitor intelligently and effectively all of the students working in the lab, whatever their level or language. But to seat two or more instructors at a single console generally results in confusion and frustration. It would seem, at present, that the monitoring features of most language laboratories serve a less than pedagogical function and they might be manned more appropriately by technicians than by teachers.

Some improvements are possible now. The use of the several dial selector systems discussed above permits the easy sifting and subsequent channeling of different students' work to individual, and much smaller, monitoring consoles. Thus, all students working on an elementary French lesson can be helped by an instructor especially assigned to them. And by permitting students to select a large number of extremely short lesson segments, the monitors would be less hesitant to interrupt a student, knowing that after their corrections, the student could immediately return to the work he had been doing without real loss of time.

Perhaps the most important function the monitor console can, with proper wiring, be made to serve in the language lab today is that of implementing and facilitating the simultaneous testing of large groups of language students. This is particularly the case if among skills being tested are those usually categorized under "oral production." Appropriately designed and wired, the monitor console can permit the examining teacher easily to accomplish the following: a) give all students spoken instructions both prior to and during testing; b) ascertain that all students are receiving the

test materials in an identical manner; c) activate and stop all student recording devices (on which individual student responses are being recorded for grading) at the same time. Note that with such an arrangement testing stimuli need not be recorded on student tapes, these being utilized solely for the recording of student responses, thus saving much time in their replay and grading.

The control of operational modes of student recorders by the monitor console is normally accomplished by electro-magnetic mechanical relays. Occasionally all relays will operate properly over a period of several hours. More typically in large lab installations this is not the case. Until other than electro-mechanical means are found--and employed--for recorder operation some amount of relay failure may be normally expected and the teacher should resign him or herself to retesting a certain percentage of students after each mass examination. This introduces factors of pre-experience which may influence the re-tested student's grade. But at this point we are in no position to split such psychometric hairs.

The development, already referred to, of the multi-tract, sixteen to thirty-two channel cartridged tape recorder will solve many of the mechanical problems experienced in present testing procedures. Not only would one recorder alone be sufficient to record the responses of up to thirty-two students, but once accomplished the task of grading would be greatly facilitated, there being but one tape to manipulate, the sampling of channels being effected by use of a single switch.

In general, the facilities provided by the lab monitoring console and its associated facilities seem most helpful in testing previous learning and in implementing research in language learning rather than in carrying out this learning itself. New, slow speed, voice activated recorders (e.g. Uher, Tandberg) placed in the console now make it possible to record all of the work (of both student and instructor) accomplished in the lab during the day. A replay and analysis of such a record should provide invaluable and exciting information to teachers and materials writers to help them improve both.

2) Electronic control gear

Under this sub-category would fall the equipment required for "blipping" control tracks on pre-recorded tapes, filter circuits used for discriminating significant elements of student responses and consequently controlling the presentation of new stimuli; "vocalic extractor" circuits for use in preparing tapes for the teaching of pronunciation and sound discrimination of students; stereo circuits permitting the separation of model and student utterances and the speech stretcher which has obvious applications in the lab but is still too expensive. This gear is in small use now because much experimentation is needed to know best how to use it. Its potential presence in the lab, however, indicates how important the language laboratory can now become not only as a teaching device but also as a research tool.